Remarks

Claims 1 - 13 are pending. Favorable reconsideration is respectfully requested.

Claim 1 has been amended for purposes of clarity. The examination of the claims appears to have been premised on compositions containing no matrix interactive reinforcing fibers. However, part b) of claim 1 requires a strain hardening amount of such fibers. Without the fibers, cement does not exhibit strain hardening behavior. Thus, the claim has always required matrix interactive fibers and did not read on 0% fibers. Applicants have voluntarily amended the claim to require a lower limit of 0.1 volume percent matrix interactive fibers. Thus, it is clear that such fibers must be included. Part f) of claim 1 has been amended to delete "optionally" and to insert a minimum of 0.1 weight percent viscosity control agent. Both the added values are contained in the specification, and therefore, no issue of new matter arises by virtue of these amendments.

The subject invention is directed to sprayable hydraulic cement compositions which exhibit strain hardening upon cure. Typically, cement is a brittle material which exhibits good compressive strength but very poor tensile behavior, as illustrated in Figure 1. As strain increases, tensile strength increases somewhat linearly (1 of Figure 1) until the strain reaches a relatively low value, at which time catastrophic failure occurs (2 in Figure 1). Quasi-brittle behavior may be achieved through the use of certain additives, for example, hollow microspheres, or by addition of non-matrix interactive fibers at high loadings. Such materials also rapidly fail at increasing strain; however the failure is gradual rather then catastrophic, (3 in Figure 1). Strain hardening behavior is illustrated by portion 4 of Figure 1. From the point of failure illustrated by both brittle and quasi-brittle materials, increasing strain results in an increase of tensile strength. This same type of behavior, although by a very different mechanism, is characteristic of ductile metals.

Claims 1 - 13 have been rejected under 35 U.S.C. § 102(a),(b) or alternatively under 35 U.S.C. § 103(a) over Drs, et al. U.S. 5,609,681 ("*Drs*") or Bürge U.S. 5,560,774 or Bürge et al., U.S. 5,453,123 ("*Bürge*"). Applicants respectfully traverse these rejections.

With respect to the two *Bürge* patents, neither of these references discloses, teaches or suggests the use of fibrous reinforcement of any kind, nor do either of the patents disclose, teach, or suggest any strain hardening behavior. Withdrawal of the rejections under 35 U.S.C. § 102 and § 103 over each of the two *Bürge* references is solicited.

Drs is directed to modifying the slump of cementitious compositions by adding, at different times, both a water soluble poly(alkylene oxide) (polyoxyalkylene glycol), a β-naphthalene sulfonate-formaldehyde condensate, and other ingredients. No strain hardening behavior is discussed. In examples 2 and 4 (the same examples are also present in Tjugum U.S. 5,681,386; ("*Tjugum*") (*Tjugum* is a coinventor of the *Drs* patent)), unspecified fibers, assumed to be polypropylene or stainless steel are added to a sprayable mix, and in Example 4, both polypropylene fibers and steel fibers are added. However, those skilled in the art are aware that neither polypropylene fibers nor stainless steel fibers are suitable in sprayable compositions (i.e. below 4 volume percent) to provide strain hardening behavior. *See, e.g.* page 10 of the specification, which clearly indicates that neither polypropylene fibers nor stainless steel fibers produce strain hardening behavior. The specification is presumptively accurate, *In re Marzocchi*, 169 U.S.P.Q. 367 (CCPA 1971). Steel fiber reinforced shot-crete is well known, but does not exhibit any strain hardening behavior. Rather, it is quasi-brittle or "strain softening".

Further evidence of the nature of the *Drs* compositions may be found in the literature, for example V.C. Li, H. Stang, and H. Krenchel, "Micromechanics of Crack-Bridging in Fiber-Reinforced Concrete", MATERIALS AND STRUCTURES, 26, p. 486-94 (1993), a copy of which is provided for the convenience of the Examiner. In this paper, concrete reinforced with polypropylene fibers and concrete reinforced with stainless steel fibers were both found to have post-peak tension-softening, not strain-hardening, behavior. It is thus clear

that the *Drs* compositions do not meet the claim limitations, nor do they render the claims obvious. Withdrawal of the rejections under 35 U.S.C. § 102 and 103 is solicited for this reason.

Drs also does not disclose or suggest a non-Newtonian thickener. The Office indicates that *Drs* uses a polyoxyalkylene oxide and queries whether these compounds may be a non-Newtonian additive. A rejection cannot be based on such speculation. Moreover, it is well known that conventional polyoxyalkylene glycols are not non-Newtonian thickeners. Rather, their very modest thickening action (high amounts are required for significant viscosity increases, and small amounts may actually reduce viscosity) is substantially shear independent. Reference may be had, for example, to the patents cited at the top of page 8 of the specification. Withdrawal of the rejections of claims 1 - 13 over *Drs* is solicited for this reason as well.

Claims 1, 2, 4 and 5 - 12 have been rejected under 35 U.S.C. § 102(a,b) and in the alternative under 35 U.S.C. § 103(a) over *Tjugum* U.S. patent 5,681,386. As indicated previously, *Tjugum's* only mention of fibers is in Examples 2 and 4 which are the same as Examples 2 and 4 of *Drs*. *Tjugum* discloses no strain hardening behavior, nor are the fibers he uses capable of such. Moreover, *Tjugum* does not disclose, teach, or suggest required non-Newtonian thickener. The claims are patentable over *Tjugum* for the same reasons discussed earlier with respect to the *Drs* patent. Withdrawal of the rejection of claims 1, 2, 4 and 5 - 12 under 35 U.S.C. §§ 102/103 is solicited.

Claims 1, 2, 4, 5 and 9 - 11 have been rejected under 35 U.S.C. §§ 102/103 over *Sugiyama et al.*, *Syntnik et al.*, or *Mitkova et al.* Applicants find no disclosure nor any teaching or suggestion of the use of reinforcing fibers of any kind in these references, nor the use of any non-Newtonian thickener. Withdrawal of the rejections of the claims based on these references is therefore solicited.

The claims have been rejected under 35 U.S.C. § 112 ¶2 as set forth on pages 5 and 6 of the Office Action. With respect to component b), a numerical lower limit has been added to the claim. With respect to component f), "optionally" has been deleted and a lower limit also added.

With respect to the non-Newtonian additive which can be a calcium aluminate cement, Applicants note that the term "hydraulically setting cement is defined on page 7, lines 4 - 7 of the specification as not including calcium aluminate cement. Thus, there is no ambiguity when such a cement is used as an inorganic non-Newtonian additive.

With respect to claims 3 and 4, Applicants believe these claims to have been clear, but have amended these without narrowing their scope by specifying that "at least one" non-Newtonian additive "is" calcium aluminate cement or an organic polymer. Two ro more different non-Newtonian additives may of course be used, as reflected in the language of claim 1. The same amendment has been made to claim 5.

With respect to claim 5, the term "associative thickener" is a term of art well known to the skilled artisan. Associative thickeners are molecules which have both hydrophillic and hydrophobic moieties which due to von der Waals forces or solvent-exclusion properties join reversibly together, or "associate" to form very high molecular weight species which exhibit great thickening effect in aqueous compositions. Upon shear, the relatively weak, associative properties are disrupted, and the species break down into smaller associates or individual molecules, which re-associate upon removal of shear. Examples are triblock polyethers with an internal hydrophilic block and strongly hydrophobic end blocks, and arc described in the patents listed at the top of page 8. *See,* for example, *Deck et al.* U.S. patent 4,640,791 "Water-Based Functional Fluids Thickened By The Interaction of An Associative Polyether Thickener and Certain Fatty Acid Amides." As this term is well known to the art, no amendment is believed unnecessary.

With respect to claim 8, "density" has been replaced by "modulus" as supported by the specification on page 10, line 23. These high modulus fibers are also high density polyethylene, and the term is well known in the polyolefin field. An example is SPECTRA® high modulus polyethylene fibers which are used, *e.g.* as reinforcement in missle radomes and for bullet proof armor. Ordinary (medium to low density) polyethylene is not suitable for use alone in the invention, as the fibers have too little strength to resist breakage, and therefore cannot contribute to strain hardening behavior. Most low density PE fibers also do not exhibit enough matrix interaction (*see*, page 9, last ¶ to page 10).

With respect to "modified" cellulose, this term is also well known to those skilled in the art. Modified celluloses are prepared by chemically derivitizing cellulose, for example by alkylation to produce the corresponding alkyl ethers (methyl cellulose, propyl cellulose), by oxyalkylation to produce hydroxyalkyl ethers such as hydroxymethyl cellulose, hydroxyethylcellulose, etc., by acylation to produce carboxyalkyl ethers, e.g. carboxymethylcellulose, and the like. The definition of "modification" may be referred to in HAWLEY'S CONDENSED CHEMICAL DICTIONARY, 11th Ed., Van Nostrand, N.Y., which discusses modification of cellulose. As this term is well known to the skilled artisan, its use in the claim does not raise any issue of indefiniteness.

It is believed that claim 13 was clear to one skilled in the art. The claim specifies the content of certain of the necessary ingredients of the sprayable composition. Applicants have added "all parts and ratios being by weight" to make certain that the Office understands that this is so. The claim does not include other ingredients which may be added, including air, other additives, etc., so a total cannot be given. Rather, the parts and ratios are internally consistent. One skilled in the art can immediately ascertain whether any given composition infringes the claim, and the claim is therefore definite.

Based on the above, withdrawal of all the rejections of the claims under 35 U.S.C. § 112 is solicited.

Applicants submit that the claims are now in condition for Allowance, and respectfully request a Notice to that effect. If the Examiner believes that further discussion will advance the prosecution of the Application, he is highly encouraged to telephone Applicants' attorney at the number given below.

Respectfully submitted,

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